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(54) SYSTEMS AND METHODS FOR MAKING DECORATIVE SHAPED METAL CANS

SYSTEME UND VERFAHREN ZUR HERSTELLUNG DEKORATIEF GEFORMTE BEHÄLTER

SYSTEMES ET PROCEDES DE FABRICATION DE BOITES METALLIQUES DECORATIVES FACONNEES

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Description

[0001] This invention relates generally to the field of consumer packaging, and more specifically to metal cans, such as the steel and aluminium cans that are commonly used for packaging soft drinks, other beverages, food and aerosol products.

[0002] Metal cans for soft drinks, other beverages and other materials are of course in wide use throughout the world. The art of making and packing metal cans is constantly evolving in response to improved technology, new materials, and improved manufacturing techniques. Other forces driving the evolution of technology in this area include raw material prices, the nature of new materials to be packaged and the marketing goals of the large companies that manufacture and distribute consumer products such as soft drinks.

[0003] Interest has existed for some time for a metal container that is shaped differently than the standard cylindrical can in such a distinctive way to become part of the product's trade dress, or to be otherwise indicative of the source or the nature of the product. To the inventors best knowledge, however, no one has yet developed a practical technique for manufacturing such an irregularly shaped can at the volume and speed that would be required to actually introduce such a product into the marketplace.

[0004] U.S.-A- 3,224,239 to Hansson, which dates from the mid 1960's, discloses a system and process for using pneumatic pressure to reshape cans. This process utilised a piston to force compressed air into a can that is positioned within a mould. The compressed air caused the can wall to flow plastically until it assumed the shape of the mould.

[0005] Technology such as that disclosed in the Hansson patent has never, to the knowledge of the inventors, been employed with any success for the reshaping of drawn and wall ironed cans. One reason for this is that the stress that is developed in the wall of the can as it is being deformed can lead to defects that are potentially failure-inducing, e.g., localised thinning, splitting or cracking. The risk of thinning can be reduced by increasing the wall thickness of the can, but this would make shaped cans so produced prohibitively expensive. The risk of splitting and cracking can be reduced by a process such as annealing, but at the expense of reduced toughness and abuse resistance of the final product.

[0006] EP-A-0,521,637 describes a method and apparatus for shaping three piece cans such as aerosol cans. The can is clamped inside a split mould and expansion of the can is achieved by pressurising the inside of the can with air under pressure. During reshaping, the height of the can is reduced by sliding an upper sleeve and clamping members axially until the clamping member engages a spacer ring. This closing up of the apparatus is said to reduce thinning of the can wall and enable greater diameter expansion.

[0007] A need exists for an improved apparatus and process for manufacturing a shaped metal can design, that is effective, efficient and inexpensive, especially when compared to technology that has been heretofore developed for such purposes, and that reduces the tendency of a shaped can to fail as a result of thinning, splitting or cracking.

[0008] Accordingly, it is an object of the invention to provide an improved apparatus and process for manufacturing a shaped metal can that is effective, efficient and inexpensive, especially when compared to technology that has been heretofore developed for such purposes, and that provides insurance against internal stresses within the can that could cause thinning, splitting or cracking.

[0009] According to the invention there is provided a method of reshaping a hollow container comprising: placing the container blank in a chamber defined by a mould, the mould having three parts; expanding the container radially outwards onto the inner surface of the mould by the use of pressurised fluid in the container blank; moving two of the mould parts towards the third from a first position in which the parts are spaced from each other by gaps to a second position in which the gaps between the mould parts are reduced in size; characterised in that the gaps open onto the mould chamber in both the first position and in the second position, after having been reduced in size, so that the gaps are not closed up during reshaping and splitting of the container due to excessive tension in the side wall is avoided. Another method is provided according to claim 15.

[0010] Preferred embodiments of the invention will now be described, by way of example, with reference to the drawings, in which:

FIGURE 1 is a cross-sectional view taken through a can body blank or pre-form that is constructed according to a preferred embodiment of the invention;
FIGURE 2 is a side elevation view of a shaped can body according to a preferred embodiment of the invention;
FIGURE 3 is a diagrammatic view of An apparatus for making a shaped can body according to a preferred embodiment of the invention;
FIGURE 4 is a fragmentary cross-sectional view through a mould unit in the apparatus depicted in FIG. 3, shown in a first condition;
FIGURE 5 is a fragmentary cross-sectional view through a mould unit in the apparatus depicted in FIG. 3, shown in a second condition;
FIGURE 6 is a schematic diagram depicting a pressure supply apparatus for the mould unit depicted in FIG. 3;
FIGURE 7 is diagrammatic depiction of a precompression step that is performed in the apparatus as depicted in FIG. 3;
FIGURE 8 is a diagrammatic depiction of a beading step in a method that is performed according to a second embodiment of the invention;

FIGURE 9 is a diagrammatic depiction of a spinning step in a method that is performed according to a second embodiment of the invention; and

FIGURE 10 is a diagrammatic depiction of a knurling step that can be performed as a second step in either the second or third embodiments of the invention referred to above.

[0011] Referring now to the drawings, wherein like reference numerals designate corresponding structure throughout the views, and referring in particular to Figures 1 and 2, a can body blank or preform 10 according to a preferred embodiment of the invention is the body of a two-piece can, which is preferably formed by the well-known drawing and ironing process. Can body blank 10 includes a substantially cylindrical side wall surface 12, a bottom 14, and necked upper portion 16. Alternatively, the upper portion of cylindrical side wall 12 could be straight.

[0012] As is well known in this area of technology, the can body blank 10 must be washed after the drawing and ironing process, and then must be dried prior to being sent to the decorator. The drying process typically is performed at a temperature of about 250 degrees Fahrenheit (which is about 121 degrees Celsius). According to one aspect of the preferred embodiment of this invention, the drying is performed at a higher temperature than is ordinary to partially anneal at least selected portions of the can body blank 10.

[0013] In Figure 1, a heat source 18 is schematically depicted, which is preferably part of the dryer assembly, but could be at any point in the apparatus prior to the moulding unit. As will be discussed in greater detail below, can body blank 10 is preferably formed of aluminium and the partial annealing is preferably accomplished at a temperature that is substantially within the range of about 375 degrees Fahrenheit (about 190.5 degrees Celsius) to about 550 degrees Fahrenheit (about 288 degrees Celsius), with a more preferred range of about 450 degrees Fahrenheit (about 232 degrees Celsius) to about 500 degrees Fahrenheit (about 260 degrees Celsius), and a most preferred temperature of about 475 degrees Fahrenheit (about 246 degrees Celsius). This is in contrast to true annealing, which would be at temperatures over 650 degrees Fahrenheit (about 353 degrees Celsius). The purpose of the partial annealing is to give the can body blank 10 enough ductility to be formed into a shaped can 20, such as is shown in Figure 2 of the drawings, but greater toughness than would be possible if the can body blank were fully annealed. Alternatively, the partial annealing could be performed in an oven such as the lacquer or decorator oven, rather than in the dryer.

[0014] Alternatively, can body blank 10 could be fabricated from steel instead of aluminium. In this case, the preferred temperature range for partial annealing would be substantially within the range of 1112 degrees Fahrenheit (600 degrees Celsius) to about 1472 degrees Fahrenheit (800 degrees Celsius). More preferably, the partial annealing would be performed at approximately 1382 degrees Fahrenheit (750 degrees Celsius).

[0015] Referring now to Figure 2, shaped can 20 is decorated and shaped distinctively in order to enhance its visual presentation to consumers. As may be seen in Figure 2, can body 20 includes a bottom 26, a shaped side wall 22 that is shaped to substantially deviate from the standard cylindrical can body shape, such as the shape of can body blank 10. The shaped side wall 22 includes areas, such as ribs 30 and grooves 32, where accentuation of such deviations from the cylindrical shape might be desired.

[0016] According to one important aspect of the preferred embodiment of the invention, decoration is provided on the external surface of the shaped side wall 22 in a manner that will accentuate those areas of the side wall where accentuation of the deviation from the cylindrical shape is desired. As may be seen in Figure 2, a first type of decoration, which may be a lighter colour, is provided on the rib 30, while a second type of decoration 36, which may be a darker colour, is provided within at least one of the grooves 32. By providing such selective decoration, and by properly registering the decoration to the deviations in the shaped side wall 22, a synergistic visual effect can be obtained that would be impossible to obtain alone by shaping the can or by decorating the can.

[0017] Referring again to Figure 2, shaped side wall 22 also has a flat area 28, where writing or a label might be applied, and is closed by a can end 24, which is applied in the traditional double seaming process.

[0018] According to the preferred method, after the partial annealing by the heat source 18 at the drying station, can body blank 10 will be transported to a decorator, where the distinctive decoration will be applied while the can body blank 10 is still in its cylindrical configuration. Markers might also be applied during the decorating process that can be used for registration of the decoration to the mould contours during subsequent forming steps, which will be described in greater detail below.

[0019] Referring now to Figure 3, an apparatus 38 is depicted which, according to the preferred embodiment of the invention, is provided to manufacture a shaped can 20 of the type that is depicted in Figure 2. As may be seen in Figures 3, 4 and 5, apparatus 38 includes a mould 40 having a mould wall 46 that defines a mould cavity 42 conforming to the desired final shape of the shaped can body 20.

[0020] As is shown diagrammatically in Figure 7, the mould 40 is of the split wall type and the mould wall 46 will include inwardly extending portions 48 that are less in diameter than the diameter D_b of the cylindrical side wall 12 of the can body blank 10 depicted by the dotted lines in Figure 7b. The mould wall 46 will also include a number of outwardly extending portions that are greater in diameter than the diameter D_b of the side wall 12 of the can body blank 10.

[0021] In other words, the inwardly extending portions 48 tend to compress the cylindrical side wall 12 of the can body blank 10 to the position 12' shown by the solid lines in Figure 7b, while the side wall 12 of the can body blank 10 must be expanded to conform to the outwardly extending portions 50 of the mould wall 46. Preferably, the perimeter of the cylindrical side wall remains a constant length when compressed in this manner so the perimeter of the cylindrical compressed side wall 12' is the same length as the circumference of the side wall 12 of the can body blank 10.

[0022] As is best shown in Figure 3, the mould unit 40 has three die parts 82, 46 and 84 which comprise neck ring, mould side wall and base support, respectively. The die parts are separated from each other by gaps or "split lines" 86 and 88. For ease of machining, the base support die 84 is made in two parts, with a central part 90 supporting the base dome of the can body. The neck ring 82 provides simple support to the necked portion of the can body. These components together define the chamber or mould cavity 42 to receive the can body and are machined to the desired final shape of the can body after blow forming. Vent holes 49 are provided (see Figures 4 and 5) to allow trapped air to escape during forming.

[0023] A pair of seal and support rings 92, 94 and a rubber sealing ring 96 are provided to seal the top edge of the container body. A space saving mandrel 98 passes through the centre of the seal and support rings 92, 94, 96 to a position just above the base support dome 84. The mandrel 98 supplies air to the cavity of a can body within the cavity 42 via a central bore 100 and radial passages 102. The apparatus further includes an upper piston and a lower piston 104, 106 which together apply a load to both ends of the can in the mould cavity 42. Lower piston 106 is moveable upwards by structure of a pressurised air supply which is fed to the piston via passage 108. Similarly, the upper piston is moveable downwards by structure of a pressurised air supply which is fed to the piston via passages 110 and 112.

[0024] In the preferred embodiment shown, the passage 110 is connected to the central bore 100 of the mandrel 98 so that the upper piston and can cavity share a common air supply. The common air supply is split for the piston 104 and cavity at the junction of the air passage 112 and the central mandrel bore 100, within the piston 104 so as to minimise losses and to maintain the same pressure supplied to the cavity and piston. Preferably, means are provided to control the flow rate of air supplied to each piston and the cavity. Cavity pressure and piston pressure can therefore be closely controlled.

[0025] A schematic circuit diagram which shows how air is supplied to the pistons and can cavity is shown in figure 6. In the figure, the upper piston 104 and seal and support rings 92,94 are shown schematically as a single unit 114. Likewise, the base support 84,90 and lower piston 106 are shown as a single unit 116. Units 114 and 116 and neck ring 82 are movable, whereas the side wall die 46 of the mould is shown fixed.

[0026] The circuit comprises two pressure supplies. Pressure supply 118 supplies pressurised air to the top piston 104 and cavity of the can within the mould cavity 42. Pressure supply 120 supplies pressurised air to the lower piston 106 only.

[0027] The two supplies each comprise pressure regulators 122,124, reservoirs 126,128, blow valves 130,132 and exhaust valves 134,136. In addition, the lower pressure supply 120 includes a flow regulator 138. Optionally, the upper pressure supply 118 may also include a flow regulator, although it is not considered essential to be able to adjust the flow in both supplies. Reservoirs 126, 128 prevent a high drop in supply pressure during the process.

[0028] Typically, high pressure air of around 30 bar is introduced to the can cavity and to drive the top of the can. The air pressure to drive the bottom piston 106 is typically around 50 bar, depending on the piston area. The air pressure within the mould cavity 42 provides the force which is required to expand the can body blank outwards but also applies an unwanted force to the neck and base of the can which leads to longitudinal tension in the can side wall. The two pistons are thus used to drive the top and the bottom of the can, providing a force which counteracts this tension in the can side wall.

[0029] The pressure of the air supplied to the pistons is critical in avoiding failure of the can during forming due to either splitting or wrinkling. Splitting will occur if the tension in the can side wall is not sufficiently counteracted by the piston pressure, since the pressure in the pistons is too low. Conversely, the pressure of the air supplied should not be so high that this will lead to the formation of ripples in the side wall.

[0030] For this reason, preferably no stops are required to limit the stroke of the pistons. If the stroke were limited, the can might not be fully expanded against the mould wall before the pistons reached the stops. If this occurs, the tension in the can side wall would cease to be balanced by the piston pressure with a consequent risk of splitting. In effect, the contact of the expanded can with the side wall of the mould prevents further movement of the pistons.

[0031] It should be noted therefore that the balance between the can cavity pressure and the piston pressure is preferably maintained at all times throughout the forming cycle so that the rate of pressure rise in the cavity and behind the pistons should be balanced throughout the cycle, particularly when the can wall yields. The rate of pressure rise can be controlled by the flow regulator 138 or by adjusting the supply pressure via the pressure regulators 122,124.

[0032] By adjusting the can cavity pressure versus the pressure that is applied to move the mould elements 82, 46, 84 towards one another, the apparatus may be operated in one of three different ways. By minimising application of pressure to the outer mould parts 82,84, the apparatus may be operated so as to simply move the

mould parts toward another without exerting any force on the can body. This will reduce the gaps 86, 88 in the mould unit 40 as the can body shrinks longitudinally during the expansion process, and will reduce but not necessarily neutralise axial tensile stress created in the side wall of the can body during expansion.

[0033] Alternatively, by providing increased pressure to drive the outer mould parts toward one another, a slight longitudinal or axial force is applied to the can body which is substantially equal to the axial tensile stress in the can body side wall, thus balancing such stress and protecting the can body from consequential weakening and possible splitting. A third mode of operation would be to provide an even greater pressure to drive the outer mould parts toward one another in order to apply an axially compressive force to the can body that would be greater than what would be necessary to cancel the tensile stress in the side wall during operation. A net compressive force is believed to be preferable provided that such a force does not lead to the formation of wrinkles.

[0034] In order to form the can, the blow valves 130,132 are first opened. It is possible to have a short delay between the opening times of the blow valves if required to obtain a better match between the piston and cavity pressures but there will then need to be a higher rate of pressure rise for one circuit in order to maintain this balance. A delay can also be used to compensate for different pipe lengths, maintaining a pressure balance at the time of forming. The upper supply 118 is split for the piston 104 and cavity as close as possible to the piston 104 as described above in reference to Figure 3.

[0035] The apparatus is designed so that, at the latest, when each piston reaches its maximum travel the can is fully reshaped and the gaps 86, 88 are not closed up at the end. Closing of the gaps can lead to splitting of the can due to excessive tension in the side wall in the same way as does limiting movement of the pistons before full expansion has occurred. However, the final gap should not be excessive since any witness mark on the side wall becomes too apparent, although removal of sharp edges at the split lines alleviates this problem.

[0036] Once the shaping operation is completed, the air is exhausted via valves 134 and 136. Clearly the exhaust valves are closed throughout the actual forming process. It is important that both supplies are vented simultaneously since the compressive force applied by the pistons to balance the cavity pressure (longitudinal tension) may be greater than the axial strength of the can so that uneven exhausting leads to collapse of the can.

[0037] As may best be seen in Figure 4, the can body blank 10 is preferably positioned within the mould cavity 42 and its interior space is sealed into communication with a source of pressurised fluid, as described above. As may be seen in Figure 4, the cavity 42 is designed so as to impart a slight compression to the can body blank 10 as it is inserted therein. This is preferably accomplished by forming the mould assembly elements into halves 52, 54, shown in Figure 4 that are split so as to be closable about the can body blank prior to pneumatic expansion of the can body blank 10.

[0038] As the mould halves 52, 54 close about the cylindrical side wall 12, the inwardly extending portions 48 of the mould wall 46 thus compress or precompress the cylindrical side wall 12 by distances up to the amount R_{in}, shown in Figure 7. After the mould has been closed and sealed and pressurised fluid is supplied into the mould cavity 46 so as to force the can body blank 10 against the mould wall 46, can body blank 10 will be forced to assume the desired final shape of the shaped can 20. The state of the shaped side wall 22 is shown after the step in Figure 5. In this step, the cylindrical side wall 12 of the can body blank 10 is expanded up to an amount R_{out}, again shown diagrammatically in Figure 7.

[0039] Preferably, the precompression that is effected by the closing of the mould halves 52, 54 is performed to deflect the side wall 12 of the can body blank 10 radially inwardly by a distance of R_{in} that is within the range of about 0.1 to about 1.5 millimetres. More preferably, this distance R_{in} is within the range of 0.5 to about 0.75 millimetres. The distance R_{out} by which cylindrical side wall 12 is radially expanded outwardly to form the outermost portions of the shaped side wall 22 is preferably within the range of about 0.1 to about 5.0 millimetres. A most preferable range for distance R_{out} is about 0.5 to 3.0 millimetres. Most preferably, R_{out} is about 2 millimetres.

[0040] To understand the benefit that is obtained by the precompression of the cylindrical side wall 12 prior to the expansion step, it must be understood that a certain amount of annealing or partial annealing may be useful, particularly in the case of aluminium can bodies, to obtain the necessary ductility for the expansion step. However, the more complete the annealing, the less strong and tough the shaped can 20 will ultimately be.

[0041] By using the precompression to get a significant portion of the differential between the innermost and outermost portions of the pattern that is superimposed onto the final shaped can 20, the amount of actual radial expansion necessary to achieve the desired pattern is reduced. Accordingly, the amount of annealing that needs to be applied to the can body blank 10 is also reduced. The precompression step, then, allows the desired pattern to be superimposed on the shaped can 20 with a minimum of annealing and resultant strength loss, thus permitting the cylindrical side wall 12 of the can body blank 10 to be formed as thinly as possible for this type of process.

[0042] As one embodiment of the invention, the mould wall may be formed of a porous material so as to allow air trapped between the side wall of the can body blank and the mould wall to escape during operation, although vent holes will probably still be required. One such material is porous steel, which is commercially available from AGA in Leydig, Sweden.

[0043] For purposes of quality monitoring and control, fluid pressure within the mould cavity 46 is monitored during and after the expansion process by structure of a pressure monitor 69, shown schematically in Figure 5. Pressure monitor 69 is of conventional construction. If the can body develops a leak during the expansion process, or if irregularities in the upper flange or neck of the can creates a bad seal with the gas probe, pressure within the mould cavity will drop much faster in the mould chamber 46 than would otherwise be the case. Pressure monitor 69 will sense this, and will indicate to an operator that the can body might be flawed.

[0044] In the case of steel cans, pressure within the mould chamber could be made high enough to form the can body into, for example, a beading-type pattern wherein a number of circumferential ribs are formed on the container.

[0045] A second method and apparatus for manufacturing a metallic can body that is shaped distinctively in order to enhance its visual presentation to consumers is disclosed in Figures 7 and 9 of the drawings. A third embodiment is depicted in Figures 8 and 9 of the drawings. According to both the second and third embodiments, a distinctively shaped metallic can body is manufactured by providing a can body blank, such as the can body blank 10 shown in Figure 1, that has a side wall 12 of substantially constant diameter, then radially deforming the can body blank 10 in selective areas by selected amounts to achieve an intermediate can body 74 that is radially modified, but is still symmetrical about its access, and then superimposing a preselected pattern of mechanical deformations onto the intermediate can body 74.

[0046] Describing now the second embodiment of the invention, a beading apparatus 62 of the type that is well known in this area of technology includes an anvil 66 and a beading tool 64. A beading apparatus 62 is used to radially deform the can body blank 10 into the radially modified intermediate can body 74 shown in Figure 9. The intermediate can body 74, as may be seen in Figure 9, has no deformations thereon that have an axial component, and is substantially cylindrical about the access of the can body 74. A knurling tool 76 is then used to superimpose the preselected pattern of mechanical deformations, in this case ribs and grooves, onto the intermediate can body, making it possible to produce a shaped can 20 of the type that is shown in Figure 2.

[0047] In the third embodiment, shown in Figures 8 and 9, a spinning unit 68 is used to deform the cylindrical side wall 12 of the can body blank 10 radially into the intermediate can body 74. Spinning unit 68 includes, as is well known in the technology, a mandrel 70 and a shaping roller 72 that is opposed to the mandrel 70. After this process, the knurling step shown in Figure 9 is preferably performed on the so formed intermediate can body 74 in a manner that is identical to that described above.

[0048] Alternatively to the knurling step shown in Figure 9, the intermediate can body 74 produced by either the method shown in Figure 7 or that shown in Figure 8 could, alternatively, be placed in a pneumatic expansion die or mould unit 40 of the type that is shown in Figures 3-5. Intermediate can body 74 would then be expanded in a manner that is identical to that described above in order to achieve the shaped can 20.

[0049] In the second and third methods described above, the can body blank 10 is also preferably partially annealed by the heat source 18 during the drying process, but, preferably, to a lesser extent than that in the first described embodiment. Preferably, the annealing for the second and third methods described above is performed at a temperature that is within the range of about 375 degrees Fahrenheit (about 190 degrees Celsius) to about 425 degrees Fahrenheit (about 218 degrees Celsius). The methods described with reference to Figures 7 and 8 thus require less annealing than that described with respect to the previous embodiment, meaning that a stronger shaped can 20 is possible at a given weight or wall thickness, or that the weight of the shaped can 20 can be reduced with respect to that produced by the first described method. Disadvantages of the second and third methods, however, include more machinery and greater mechanical complexity, as well as more wear and tear on the cans, spoilage and possible decoration damage as a result of the additional mechanical processing and handling.

[0050] It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed. Alternatively, for example, can body blank 10 could be formed by alternative processes, such as a draw-redraw process, a draw-thin-redraw process, or by a three-piece welded or cemented manufacturing process.

Claims

1. A method of reshaping a hollow container comprising:

    placing the container blank in a chamber (42) defined by a mould (40), the mould having three parts (82, 46, 84);
    expanding the container radially outwards onto the inner surface of the mould by the use of pressurised fluid in the container blank;
    axially moving two of the mould parts towards the third from a first position in which the parts are spaced from each other by gaps (86, 88) to

a second position in which the gaps between the mould parts are reduced in size;

characterised in that the gaps (86, 88) open onto the mould chamber in both the first position and in the second position, after having been reduced in size, so that the gaps are not closed up during reshaping and splitting of the container due to excessive tension in the side wall is avoided.

2. A method according to claim 1, **characterised by** positioning the gaps at the points of maximum expansion of the container.

3. A method according to claim 1 or claim 2, **characterised by** applying a load to at least one end of the container.

4. A method according to claim 3, **characterised by** balancing the force exerted by the pressurised fluid on the interior of the container and the load applied to the end or the ends of the container.

5. A method according to any one of claims 1 to 4, **characterised in that** the parts are moved together with a force which is sufficient to exert a net compressive force on the side wall of the container during shaping.

6. A method according to any one of claims 1 to 4, **characterised in that** the parts are moved together with a force which is sufficient to balance forces in the side wall of the container during shaping.

7. An apparatus for reshaping a hollow container by the method of any one of claims 1 to 6, comprising

   a mould (40) having three parts (82, 46, 84) defining a chamber (42) to accommodate the container;
   a fluid supply for providing a pressurised fluid in the hollow container to expand the container radially outwards onto the inner surface of the mould; and
   means for moving axially two of the mould parts towards the third from a first position in which the parts are spaced from each other by gaps (86, 88) to a second position in which the gaps between the mould parts are reduced in size **characterised in that** the gaps (86,88) open into the mould chamber.

8. An apparatus according to claim 7, in which the gaps in the mould are positioned at the points of maximum expansion of the container.

9. An apparatus according to claim 7 or claim 8, further comprising means for applying a load to at least one end of the container.

10. An apparatus according to claim 9, in which the means for applying a load comprises at least one piston (104, 106).

11. An apparatus according to claim 10, in which the pistons are actuated by fluid pressure.

12. An apparatus according to claim 11, in which the pressurised fluid is supplied either independently or to any combination of the piston or pistons and interior of the container.

13. An apparatus according to claim 11 or claim 12, in which a single pressurised fluid line supplies the piston, or one of the pistons and the interior of the container, and is split adjacent to or within the piston.

14. An apparatus according to any one of claims 9 to 13, in which contact of the expanded container with the mould wall prevents further movement of the loading means, whereby the loading means will not reach the limit of its movement before the container is fully reshaped.

15. A method of reshaping a container blank for a two piece can, the blank comprising a side wall and integral base, into a shape having two or more enlarged regions, the method comprising:

   placing the container blank into a chamber (42) defined by a mould (40) having three parts (82, 46, 84) spaced from each other by gaps (86, 88) which open into the mould chamber and each of which is substantially at the position of maximum expansion of one of the enlarged regions;
   expanding the container blank radially outwards onto the inner surface of the mould by the use of a pressurised fluid in the container blank; and
   moving two of the mould parts towards the third as the can is being expanded.

Patentansprüche

1. Verfahren zum Nachverformen eines hohlen Behälters, welches aus den folgenden Schritten besteht:

   Anordnen des Behälterzuschnitts in einer Kammer (42) die durch eine Form (40) begrenzt wird, wobei die Form drei Teile (82, 46, 84) aufweist;

   Radiales Expandieren des Behälters in aus-

wärtiger Richtung und auf die innere Oberfläche der Form hin unter Benutzung eines Druckfluids innerhalb des Behälterzuschnitts;

Axiales Bewegen von zweien der Formteile in Richtung auf das dritte hin ausgehend von einer ersten Position, in der die Teile voneinander über Spalte (86, 88) beabstandet sind zu einer zweiten Position, in der die Spalte zwischen den Formteilen in ihrer Größe vermindert sind, **dadurch gekennzeichnet,**

dass die Spalte (86, 88) in Richtung auf die Formgebungskammer hin offen sind, und zwar sowohl in der ersten als auch in der zweiten Position, nachdem diese in ihrer Größe vermindert worden ist, so dass die Spalte während des Nachverformens nicht geschlossen sind und eine Spaltung des Behälters aufgrund einer übermäßigen Zugspannung in der Seitenwand vermieden wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Spalte an Stellen der größten Expansion des Behälters angeordnet werden.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** auf wenigstens ein Ende des Behälters eine Kraft ausgeübt wird.

4. Verfahren nach Anspruch 3, **dadurch gekennzeichnet, dass** die über das Druckfluid auf den Innenraum des Behälters ausgeübte Kraft und die, auf das Ende oder die Enden des Behälters ausgeübte Kraft ausgeglichen werden.

5. Verfahren nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Teile in Richtung aufeinander zu unter Verwendung einer Kraft bewegt werden, die ausreichend ist, eine nutzbare Kompressionskraft auf die Seitenwand des Behälters während des Gestaltungsverfahrens auszubringen.

6. Verfahren nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Teile in Richtung aufeinander zu unter Verwendung einer Kraft bewegt werden die ausreichend ist, die in der Seitenwand des Behälters während des Gestaltungsverfahrens wirksamen Kräfte auszugleichen.

7. Vorrichtung zum Nachverformen eines hohlen Behälters entsprechend dem Verfahren nach einem der Ansprüche 1 bis 6, bestehend aus

einer Form (40), die drei Teile (82, 46, 84) aufweist, die eine zur Aufnahme des Behälters bestimmte Kammer (42) definieren;

einer Fluidversorgung zur Bereitstellung eines Druckfluids innerhalb des hohlen Behälters, um den Behälter in radial auswärtiger Richtung und auf die innere Oberfläche der Form hin zu expandieren und

Mitteln zur axialen Bewegung von zweien der Formteile in Richtung auf das dritte hin, und zwar ausgehend von einer ersten Position, in der die Teile voneinander durch Spalte (86, 88) beabstandet sind, in Richtung auf eine zweite Position hin, in der die Spalte zwischen den Teilen in ihrer Größe vermindert sind, **dadurch gekennzeichnet,**

dass die Spalte (86, 88) zu dem Formgebungsraum hin offen sind.

8. Vorrichtung nach Anspruch 7, wobei die Spalte der Form an Stellen einer größten Expansion des Behälters angeordnet sind.

9. Vorrichtung nach Anspruch 7 oder 8, welche ferner Mittel zur Aufbringung einer Kraft auf wenigstens ein Ende des Behälters aufweist.

10. Vorrichtung nach Anspruch 9, wobei die Mittel zur Aufbringung einer Kraft zumindest einen Kolben (104, 106) umfassen.

11. Vorrichtung nach Anspruch 10, wobei die Kolben über ein Druckfluid betätigt werden.

12. Vorrichtung nach Anspruch 11, wobei das Druckfluid dem Kolben oder den Kolben und dem Innenraum des Behälters entweder unabhängig oder in irgendeiner Kombination zugeführt wird.

13. Vorrichtung nach Anspruch 11 oder 12, wobei eine einzelne Druckfluidleitung den Kolben oder einen der Kolben und den Innenraums des Behälters versorgt und in der Nähe des oder innerhalb des Kolbens verzweigt ist.

14. Vorrichtung nach einem der Ansprüche 9 bis 13, wobei eine Berührung des expandierten Behälters mit der Formwand eine weitere Bewegung der Kraftübertragungsmittel verhindert, so dass die Kraftübertragungsmittel den Endpunkt ihrer Bewegung nicht erreichen, bevor der Behälter vollständig nachverformt ist.

15. Verfahren zum Nachverfomen eines Behälterzuschnitts mit Hinblick auf eine zweiteilige Dose, wobei der Zuschnitt eine Seitenwandung und einen einstückig mit dieser ausgebildeten Boden aufweist, zu einer Gestalt, die mit einem oder zwei vergrößerten Bereichen versehen ist, welches durch

die folgenden Schritte **gekennzeichnet** ist:

Anordnen des Behälterzuschnitts in einer Kammer (42), die durch eine Form (40) begrenzt ist, die drei, voneinander durch Spalte (86, 88) beabstandete Teile (82, 46, 84) aufweist, welche Spalte in Richtung auf die Formgebungskammer hin offen sind und deren jeder sich im Wesentlichen an einer Stelle größter Expansion einer der vergrößerten Bereiche befindet;

Expandieren des Behälterzuschnitts in radial auswärtiger Richtung und auf die innere Oberfläche der Form hin unter Gebrauch eines Druckfluids innerhalb des Behälterzuschnitts und

Bewegen zweier der Formteile in Richtung auf das dritte hin während die Dose expandiert wird.

Revendications

1. Procédé de refaçonnage d'un récipient creux comprenant :

   la mise en place de l'ébauche du récipient dans une chambre (42) définie par un moule (40), le moule ayant trois parties (82, 46, 84) ;
   l'expansion du récipient radialement vers l'extérieur jusque sur la surface intérieure du moule en utilisant un fluide sous pression dans l'ébauche du récipient ;
   le déplacement axial de deux des parties du moule vers la troisième partie depuis une première position dans laquelle les parties sont espacées les unes des autres par des espaces (86, 88) jusqu'à une seconde position dans laquelle la dimension des espaces entre les parties du moule est réduite ;

   caractérisé en ce que les espaces (86, 88) débouchent sur la chambre du moule à la fois dans la première position et dans la seconde position, après que leur dimension a été réduite, afin que les espaces ne soient pas fermés pendant le refaçonnage et qu'un éclatement du récipient sous l'effet d'une traction excessive dans la paroi latérale soit évité.

2. Procédé selon la revendication 1, **caractérisé par** le positionnement des espaces aux points d'expansion maximale du récipient.

3. Procédé selon la revendication 1 ou la revendication 2, **caractérisé par** l'application d'une charge à au moins une extrémité du récipient.

4. Procédé selon la revendication 3, **caractérisé par** l'équilibrage de la force exercée par le fluide sous pression sur l'intérieur du récipient et de la charge appliquée à l'extrémité ou aux extrémités du récipient.

5. Procédé selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** les parties sont rapprochées les unes des autres avec une force qui est suffisante pour exercer une force de compression nette sur la paroi latérale du récipient pendant le refaçonnage.

6. Procédé selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** les pièces sont rapprochées les unes des autres avec une force qui est suffisante pour équilibrer les forces dans la paroi latérale du récipient pendant le refaçonnage.

7. Appareil pour refaçonner un récipient creux par le procédé selon l'une quelconque des revendications 1 à 6, comportant

   un moule (40) ayant trois parties (82, 46, 84) définissant une chambre (42) destinée à loger le récipient ;
   une alimentation en fluide destinée à amener un fluide sous pression dans le récipient creux pour expanser le récipient radialement vers l'extérieur jusque sur la surface intérieure du moule ; et
   un moyen pour déplacer axialement deux des parties du moule vers la troisième partie depuis une première position dans laquelle les parties sont espacées les unes des autres par des espaces (86, 88) jusqu'à une seconde position dans laquelle la dimension des espaces entre les parties du moule est réduite, **caractérisé en ce que** les espaces (86, 88) s'ouvrent dans la chambre du moule.

8. Appareil selon la revendication 7, dans lequel les espaces dans le moule sont positionnés aux points d'expansion maximale du récipient.

9. Appareil selon la revendication 7 ou la revendication 8, comportant en outre un moyen destiné à appliquer une charge à au moins une extrémité du récipient.

10. Appareil selon la revendication 9, dans lequel le moyen destiné à appliquer une charge comporte au moins un piston (104, 106).

11. Appareil selon la revendication 10, dans lequel les pistons sont actionnés par la pression d'un fluide.

12. Appareil selon la revendication 11, dans lequel le

fluide sous pression est fourni soit indépendamment, soit à une combinaison quelconque du piston ou des pistons et de l'intérieur du récipient.

13. Appareil selon la revendication 11 ou la revendication 12, dans lequel une conduite de fluide sous pression unique alimente le piston, ou l'un des pistons et l'intérieur du récipient, et est divisée à proximité immédiate ou à l'intérieur du piston.

14. Appareil selon l'une quelconque des revendications 9 à 13, dans lequel l'entrée en contact du récipient expansé avec la paroi du moule empêche la poursuite du mouvement du moyen d'application d'une charge, grâce à quoi le moyen d'application d'une charge n'atteint pas la limite de son mouvement avant que le récipient soit totalement refaçonné.

15. Procédé de refaçonnage d'une ébauche de récipient pour une boîte en deux pièces, l'ébauche comportant une paroi latérale formée d'une seule pièce avec une base, en une forme ayant deux ou plus de deux régions agrandies, le procédé comprenant :

la mise en place de l'ébauche du récipient dans une chambre (42) définie par un moule (40) ayant trois parties (82, 46, 84) espacées les unes des autres par des intervalles (86, 88) qui s'ouvrent dans la chambre du moule et dont chacun est sensiblement dans la position d'expansion maximale de l'une des régions agrandies ;
l'expansion de l'ébauche du récipient radialement vers l'extérieur jusque sur la surface intérieure du moule en utilisant un fluide sous pression dans l'ébauche du récipient ; et
le déplacement de deux des parties du moule vers la troisième partie pendant que la boîte est en cours d'expansion.

FIG. 1

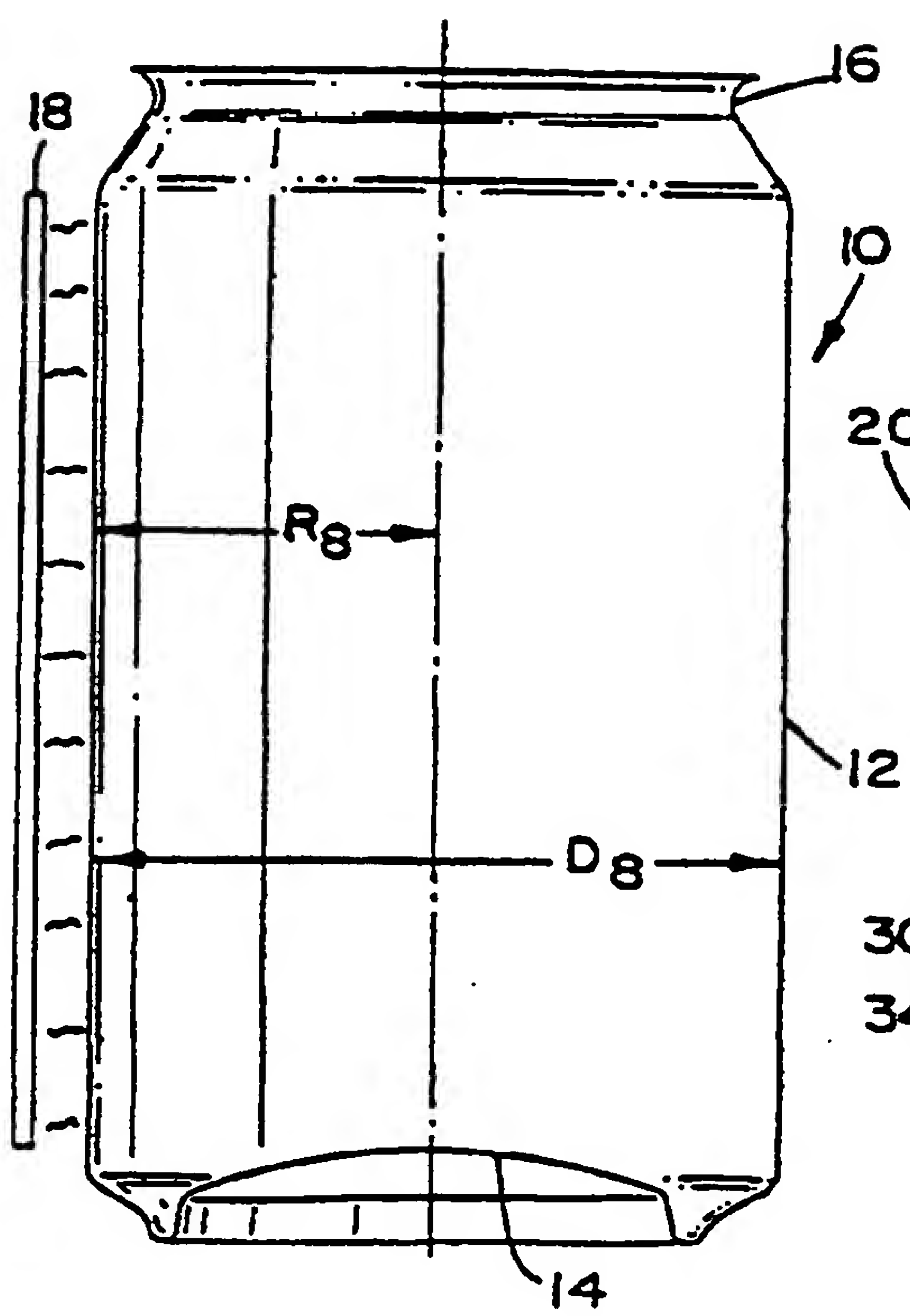


FIG. 2

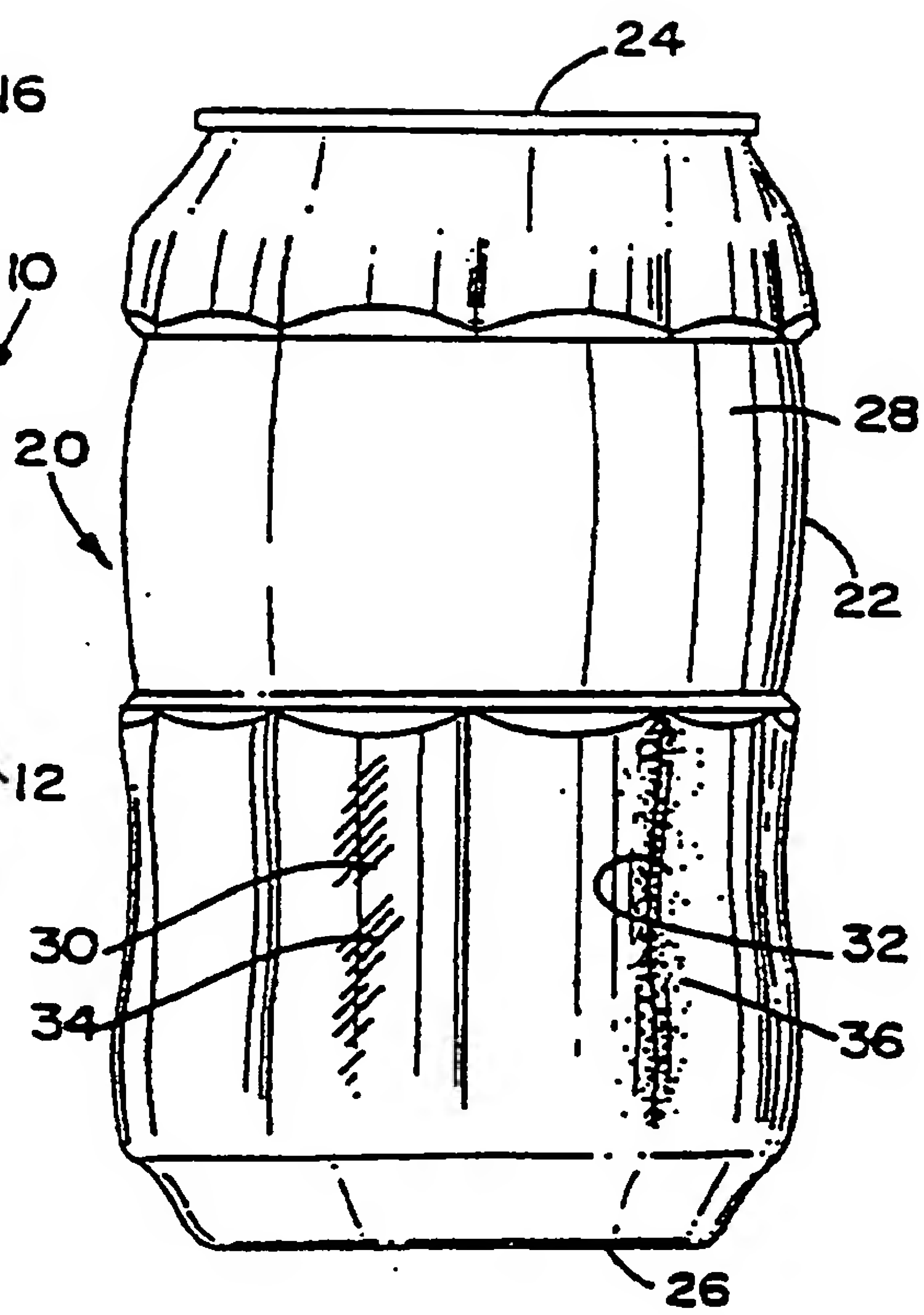


FIG. 3

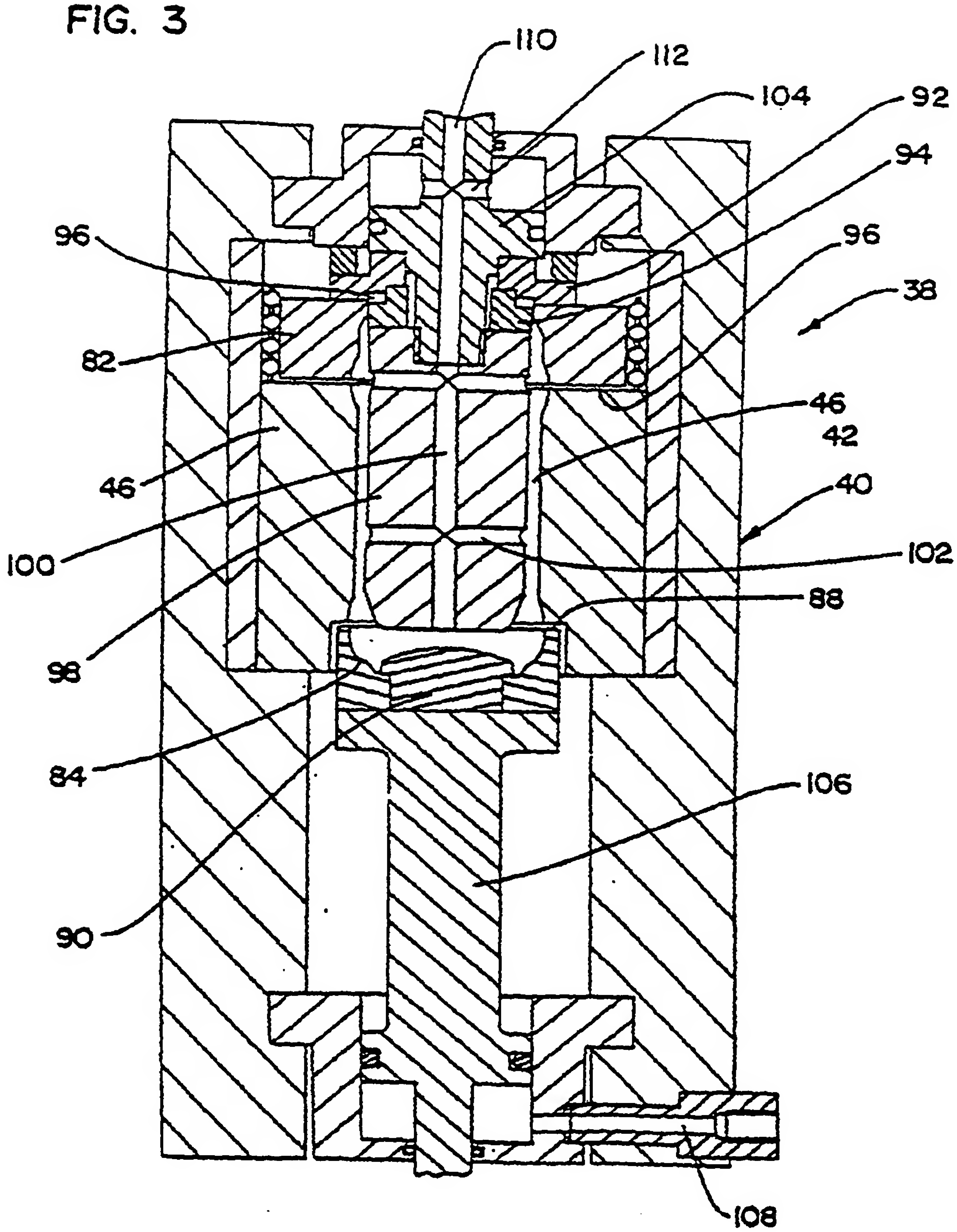


FIG. 4

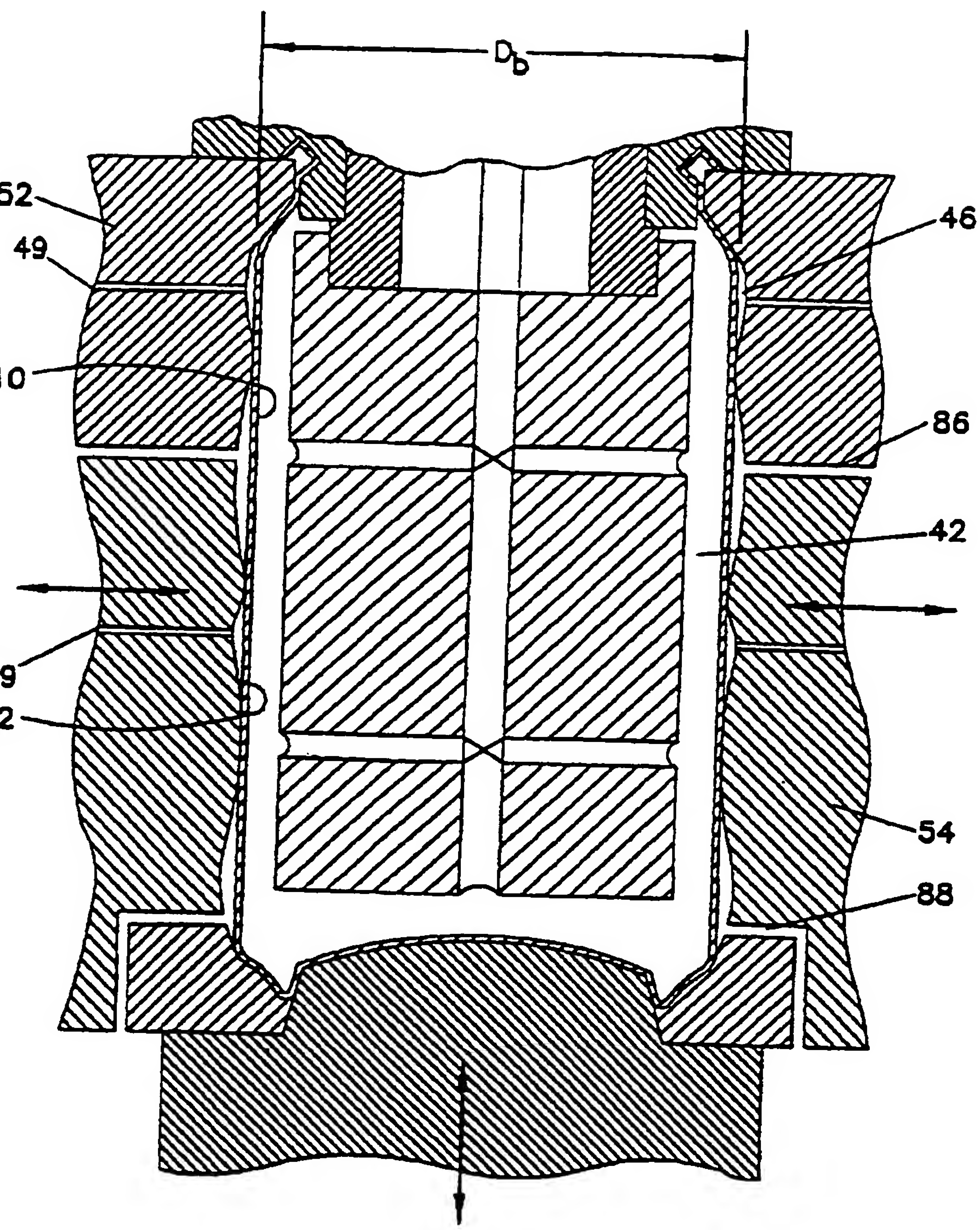
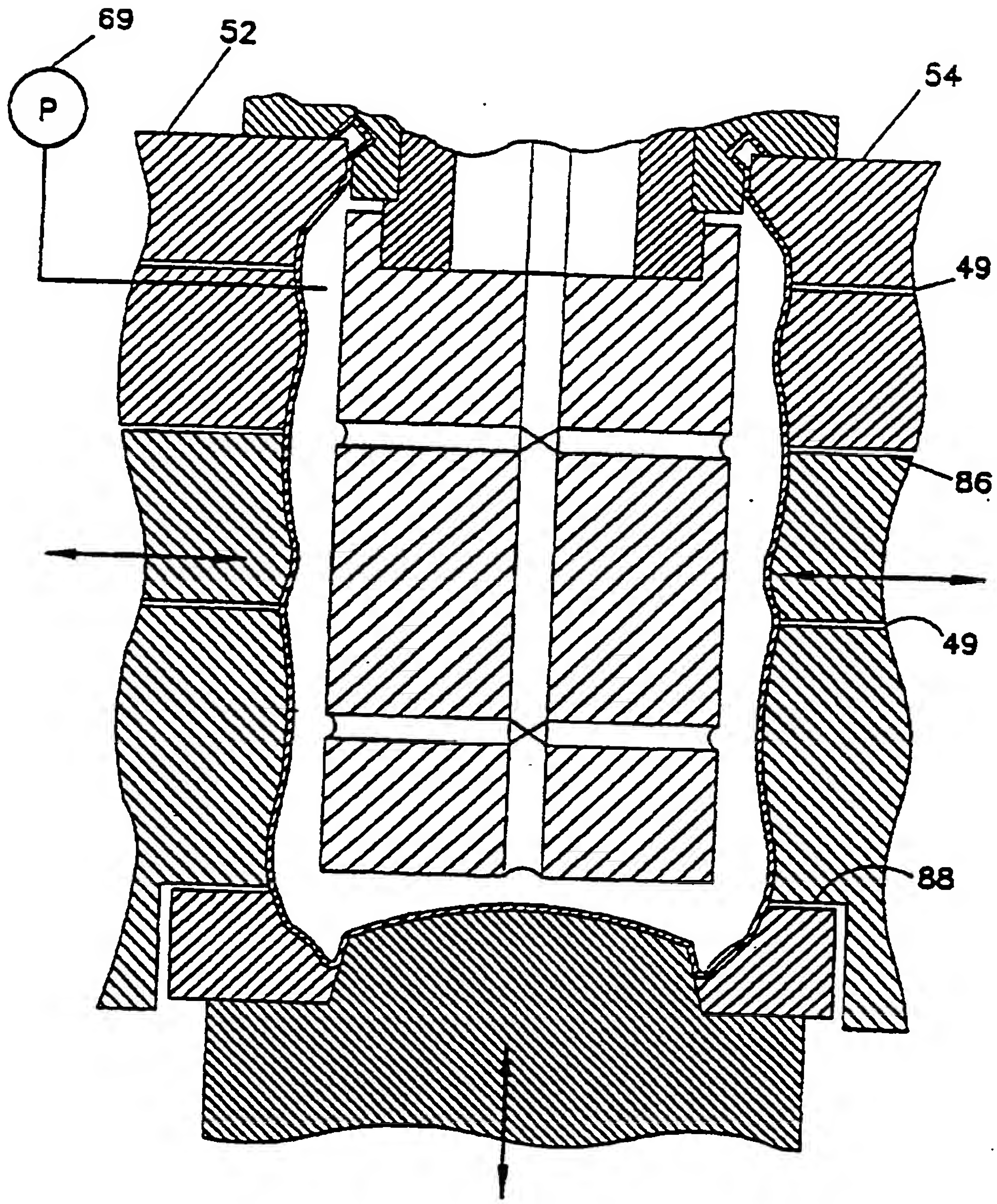


FIG. 5



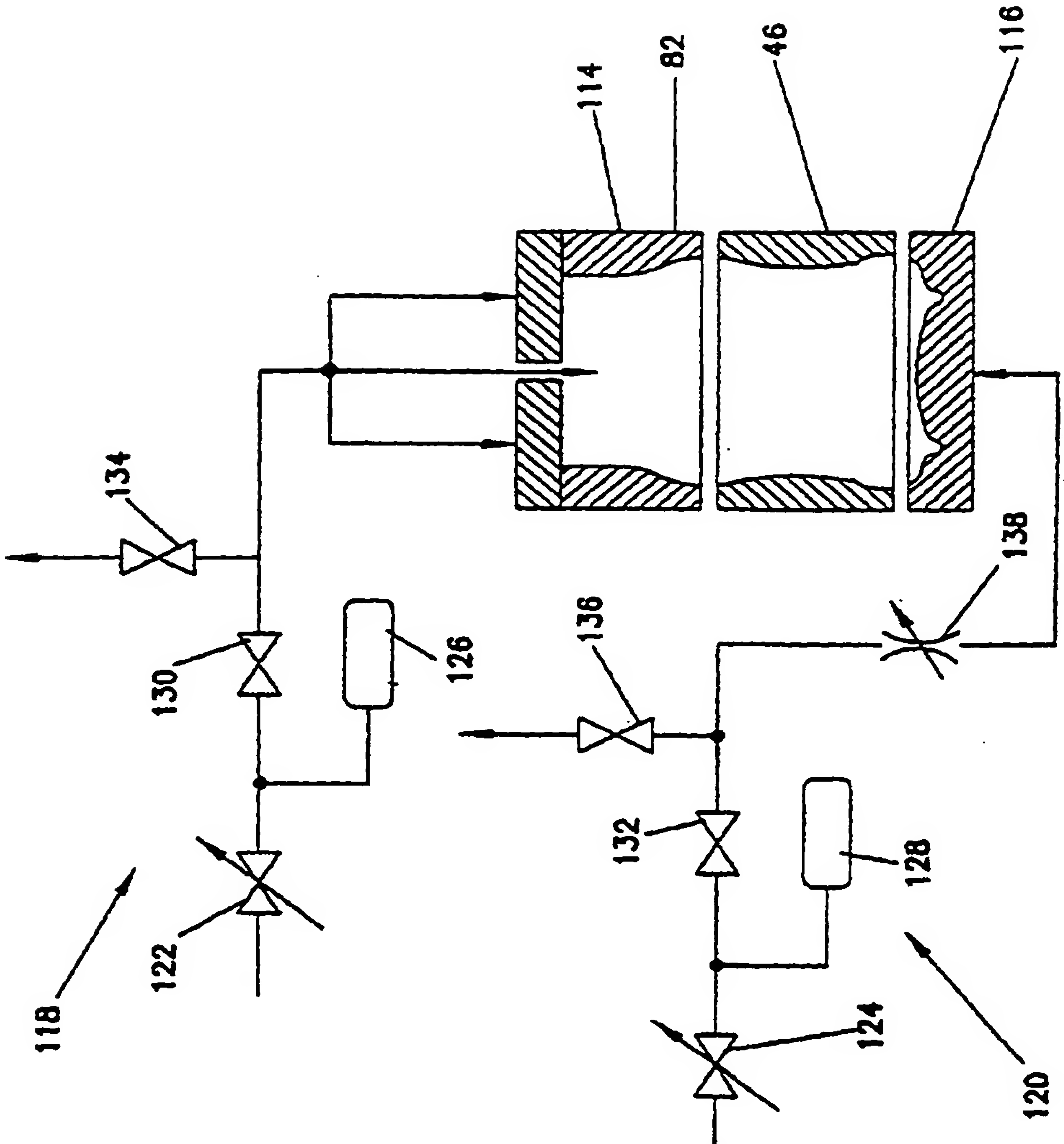


FIG. 6

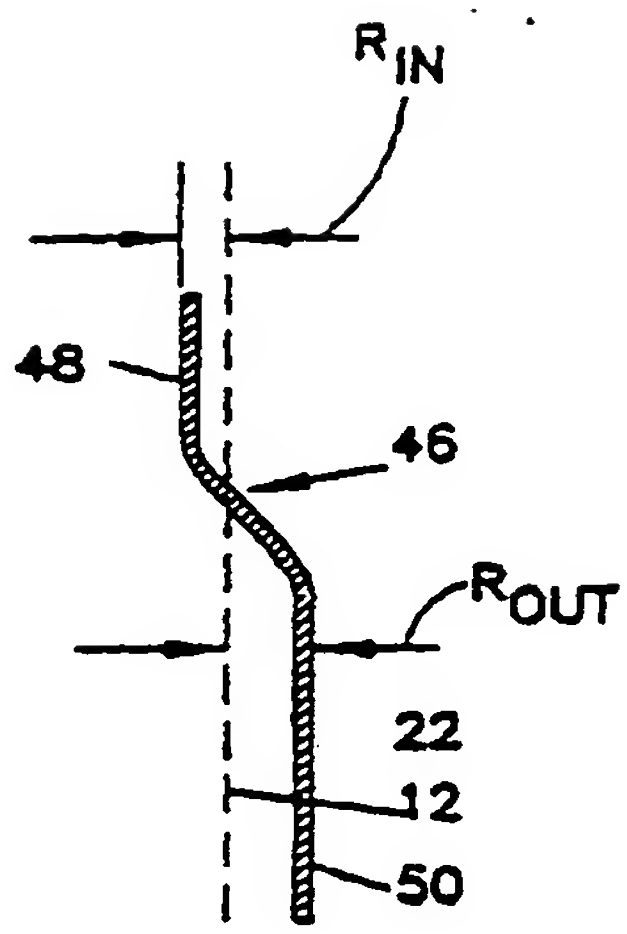


FIG. 7a

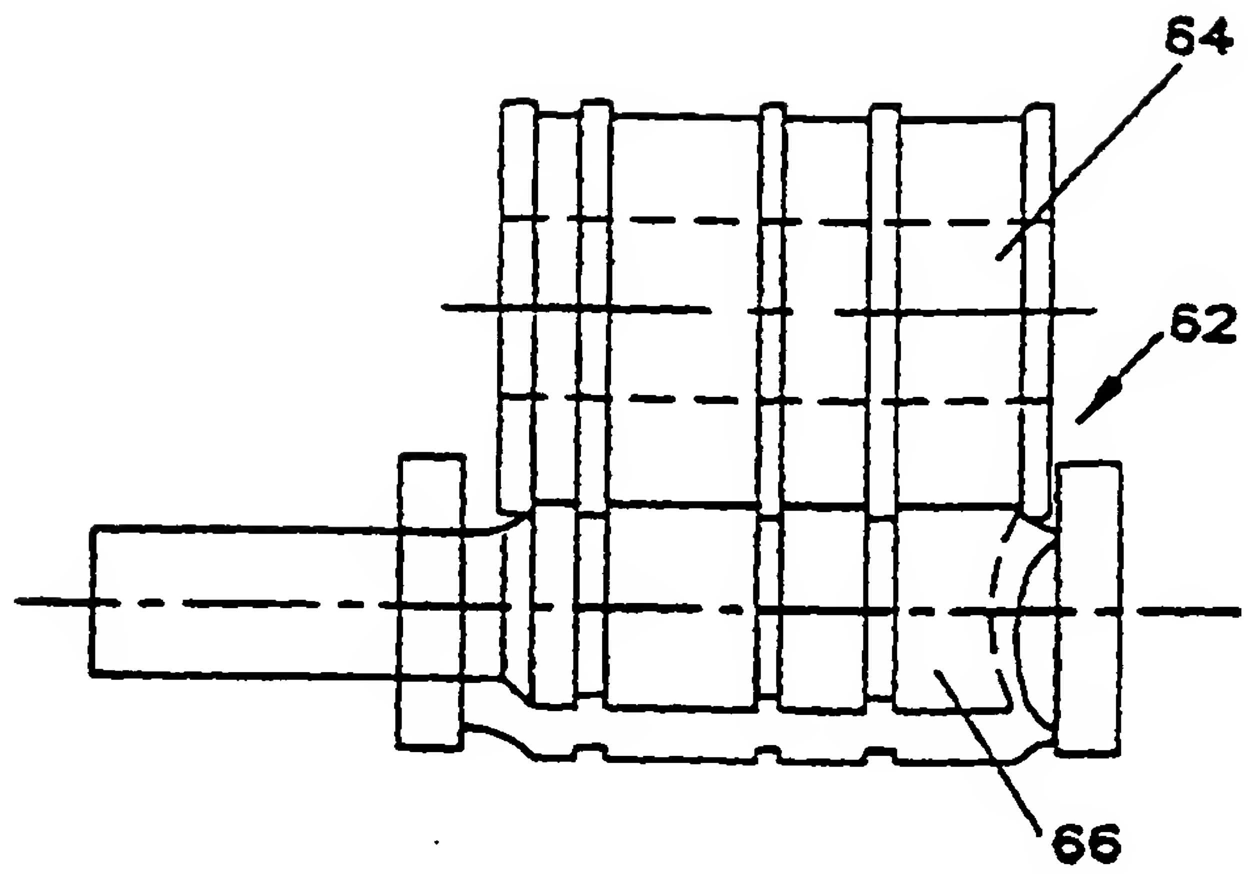


FIG. 8

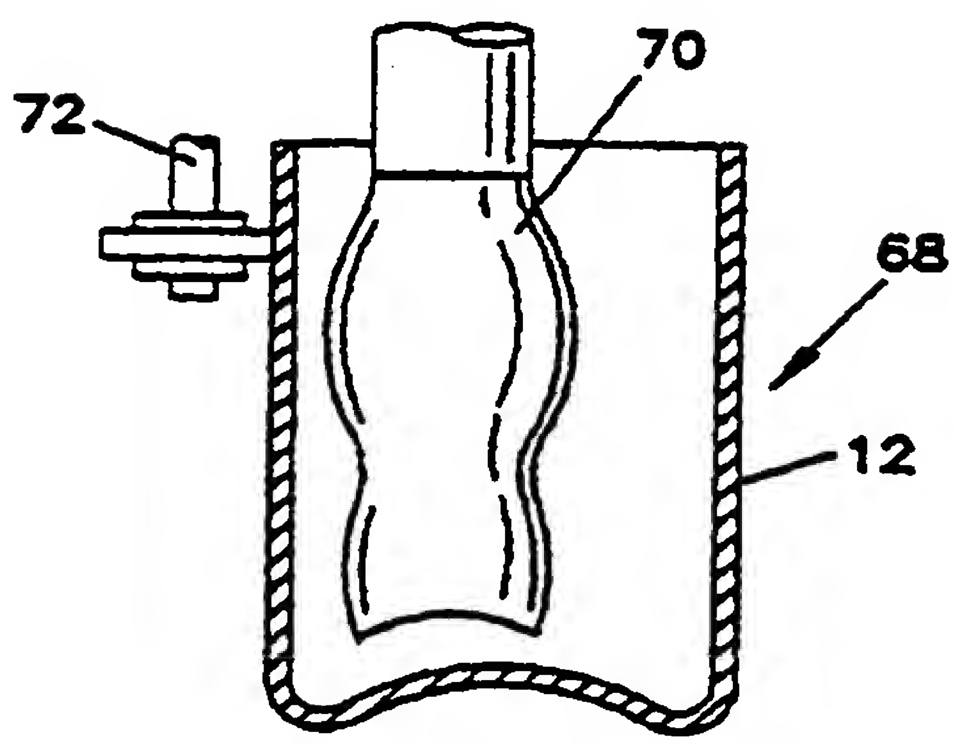


FIG. 9

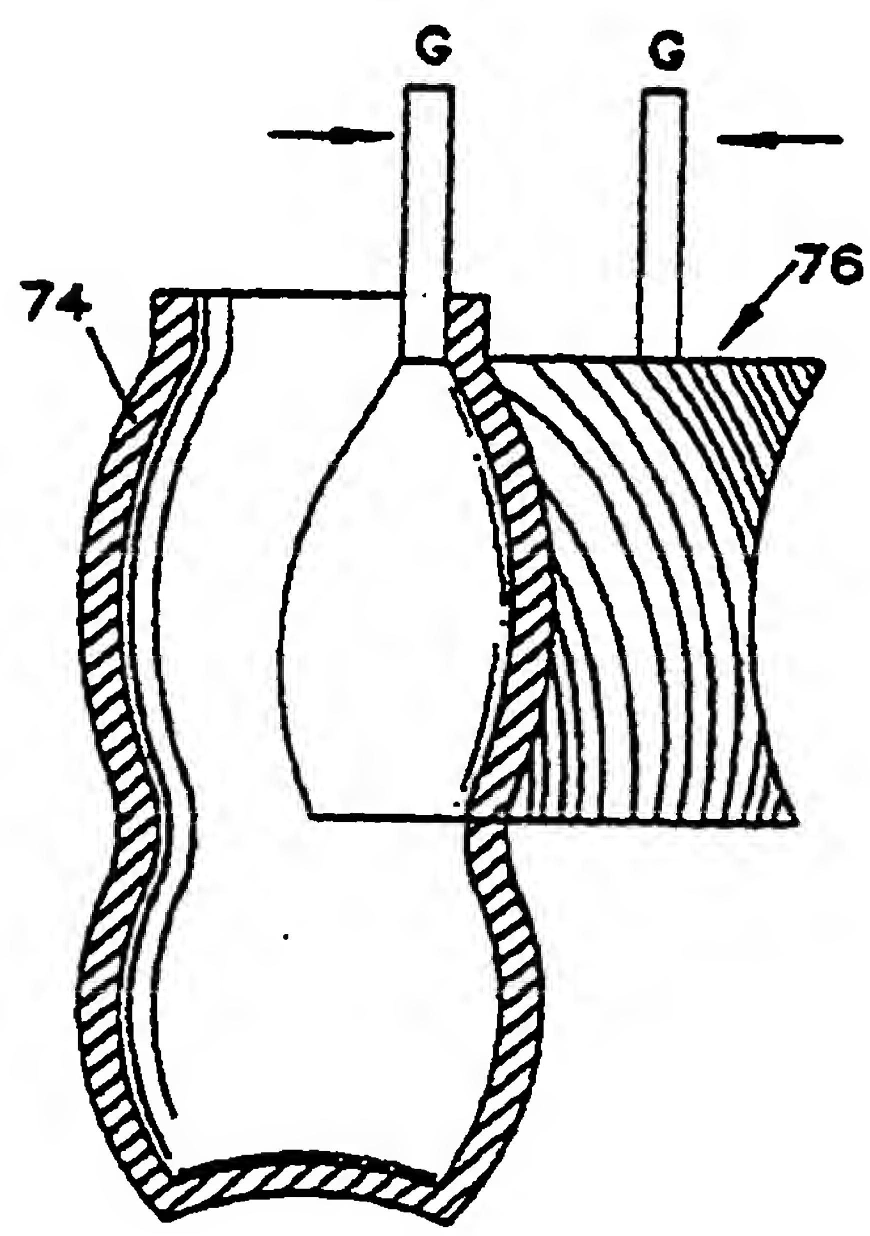


FIG. 10

FIG. 7b